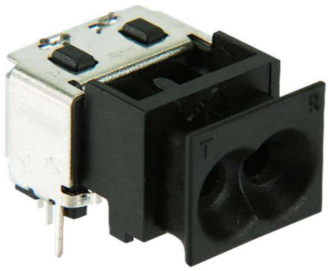
FB01GKUJ

1.25 Gbps 850 nm, Industrial Fiber Optic OptoLock® Transceiver

Datasheet

RoHS

CLASS 1
LASER PRODUCT



DESCRIPTION

Firecomms' plugless OptoLock® transceiver features a small form factor housing containing a CMOS based integrated transmitter and receiver pair of opto-electronic components lensed for direct termination to Plastic Optical Fiber (POF). This port for bare fiber significantly simplifies the optical connection, (no plug required) thus reducing installation and maintenance time for industrial, medical and consumer applications.

The 1.25 Gbps OptoLock® transceiver combines an 850 nm transmitter with a high-speed receiver within a compact device capable of delivering bi-directional data links over 1 mm Step-index Plastic Optical Fiber (SI-POF). For lower power and green designs, the transceiver uses VCSEL (Vertical Cavitiy Surface Emitting Laser) technology to deliver operating power consumptions of less than 50 mW which further reduces to a typical value of 28 uW when placed into sleep mode.

OptoLock® is protected by U.S. patents 7,597,485 and 7,905,665, Chinese patents 101501545 A and 102135650 B and other international patents.

AVAILABLE OPTIONS

Table 1
ORDERING INFORMATION / PART NUMBER

Industrial OptoLock® 1.25 Gbps Transceiver, 2.2 mm POF, Black	FB01GKUJ

FEATURES

- Simple low-cost termination solution for 2.2 mm jacketed POF cables without a plug
- Compatible with 8B/10B encoding schemes
- Integrated optics for efficient coupling to 0.5NA POF
- Less than 50 mW power dissipation with power saving features
- Configured with receive signal strength indicator (RSSI)
- RoHS compliant and lead free
- Temperature operating range: -40 °C to +85 °C
- Class 1 laser

Table 2
APPLICATIONS

Application	High Speed Bidirectional Industrial and Robotic Links
Distance	High Speed POF links up to 3 meters over Step Index POF [1]
Speed	1.25 Gbps

Note: 1. Maximum link lengths will vary with installation conditions and operating data rate.

SPECIFICATIONS

Table 3
TRANSCEIVER PIN DESCRIPTION

Pin	Name	Symbol
	Transmitter	
1	EMI Shield [1]	GND
2	Signal Input (Negative)	TD-
3	Signal Input (Positive)	TD+
4	Ground Pin [1]	GND
5	DC Power Input Pin 3.3 V	Vcc
6	Enable (Active High)	EN
	Receiver	
7	DC Power Input Pin 3.3 V	Vcc
8	Ground Pin [1]	GND
9	Receive Signal Strength Indicator	RSSI
10	Data Output (Negative)	RD-
11	Data Output (Positive)	RD+
12	EMI Shield [1]	GND

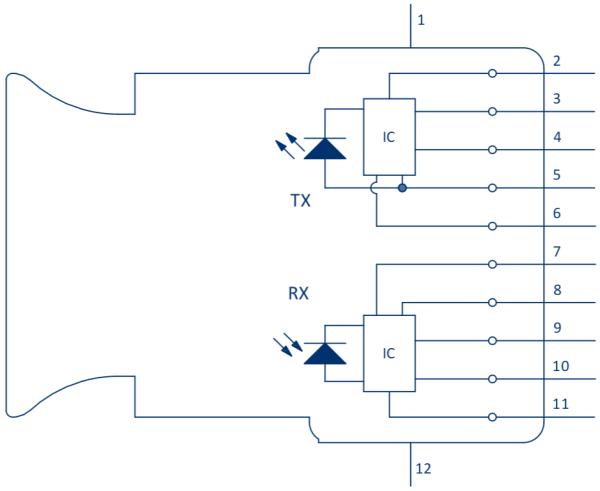


FIGURE1
Transceiver pin-out, top view

1. N.B.: EMI Shield ground pins must be connected to the signal ground plane on the PCB. This is important to prevent cross-talk between Tx and Rx and also to shield the components from external EMI/EMC and ESD.

ELECTRICAL INTERFACE

Figure 2 shows a typical interface circuit. Each Ethernet PHY manufacturer recommends a termination configuration for their own design.

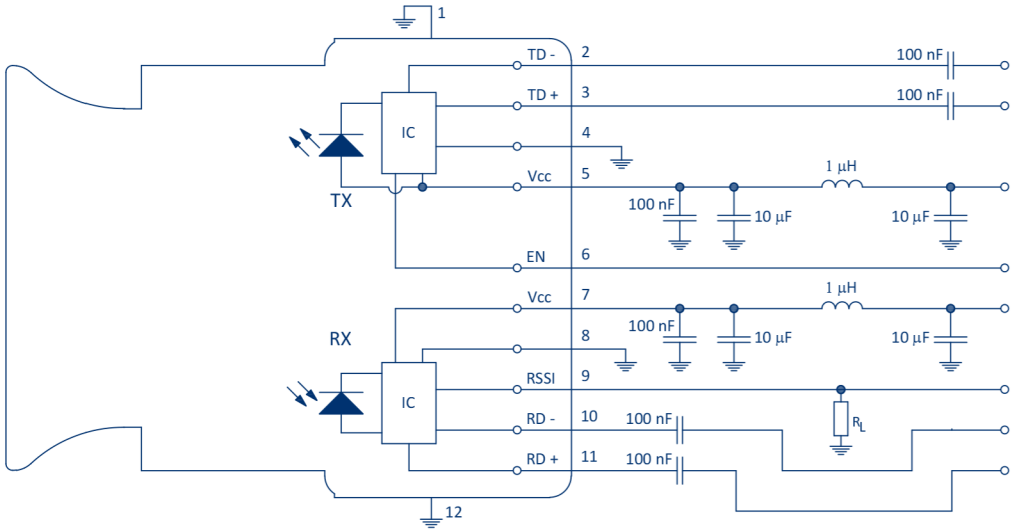


FIGURE2
Interface circuit schematic to AC couple to an Ethernet PHY

Notes:

1. *The transmitter and receiver are electrically shielded from each other to prevent crosstalk to be effective this shield must be grounded.*
2. *Power line capacitors should be located as close as possible to the components DC power PINs.*
3. *The data lines are impedance-matched differential pairs. The PCB layout for these tracks must comply to IEEE standards for high-speed data and impedance matching.*
4. *RSSI is a 1:1 current mirror of the photodiode current and can be used as an RSSI output by dropping across a 1 k resistor.*
5. *EN activates the transmitter IC and is an active high CMOS input.*

OUTPUT VOLTAGE LEVELS

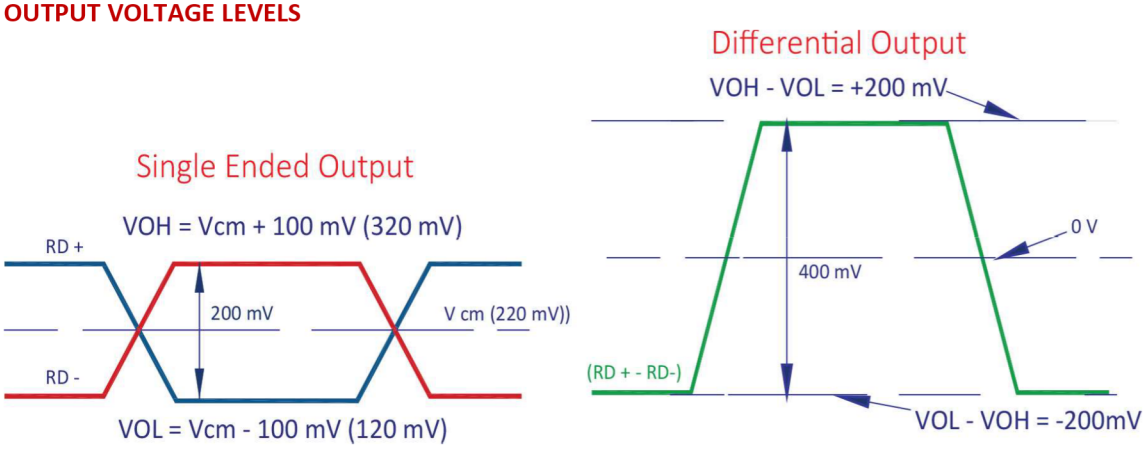


FIGURE 3
On the left the typical Optical Receiver output voltage swing as seen from each output (single ended) and on the right as the differential measurement across both outputs

ENABLE

An Enable pin is available to activate/deactivate the transmitter IC which is a CMOS type logic input. This feature is an active high input and should therefore be pulled to Vcc in order to activate the Tx IC operation. When pulled to ground the Tx IC is switched off and no light is generated. This input can be used for both power saving and eye-safe maintenance operation.

RSSI

This OptoLock® transceiver provides a Received Signal Strength Indicator (RSSI) current output from the receiver. The RSSI output indicates the Average Optical Power (AOP) falling on the receiver. This RSSI signal therefore provides a health status indication that can be communicated to the user and wider network. To use the RSSI output, place a resistor (R_L) between RSSI pin and ground to generate V_{RSSI} analogue voltage; V_{RSSI} is proportional to the AOP. This V_{RSSI} output can then be used as an input into a signal monitoring circuit.

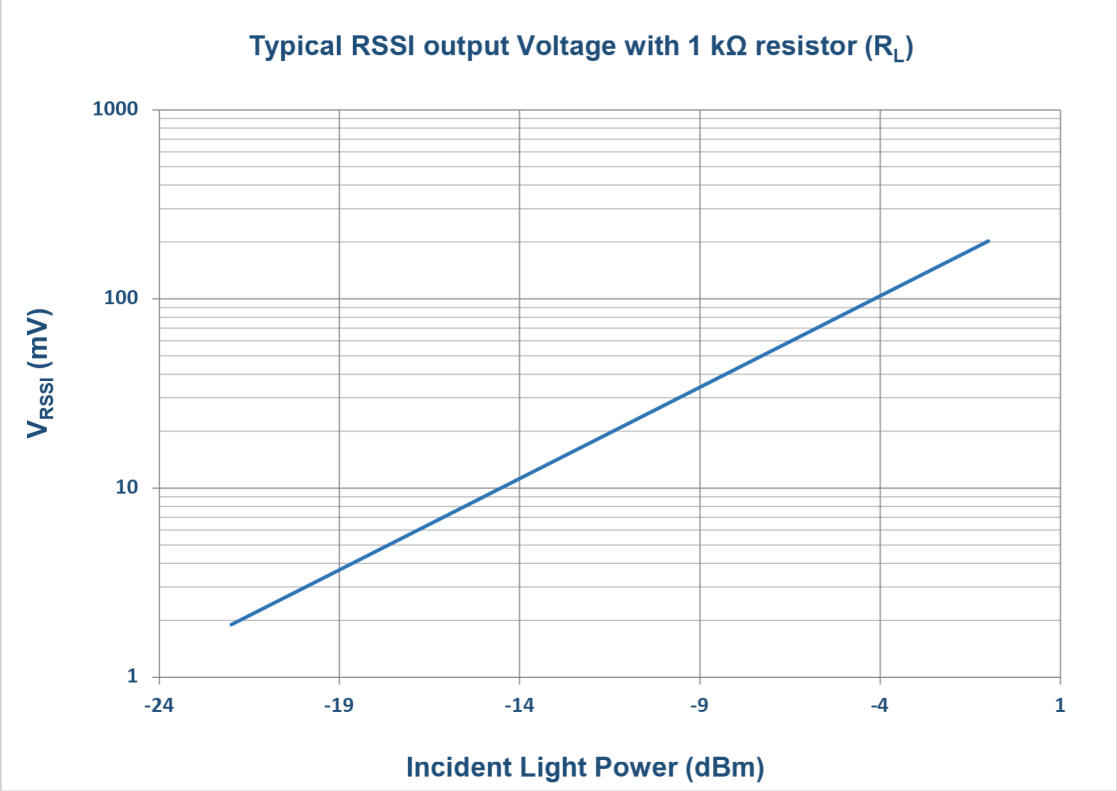


FIGURE 4
A graph of the Voltage (V_{RSSI}) generated across the RSSI resistor (R_L) versus the light power incident on the photodiode as per the circuit shown in Figure 2

SPECIFICATIONS

Table 4
REGULATORY COMPLIANCE

Parameter	Symbol	Standard	Level
Storage Compliance	MSL	J-STD-020	2a (4-week floor life)
Restriction of Hazardous Substances Directive	RoHS	Directive 2011/65/EU Incl. Amendment 2015.863	Certified Compliant
Eye Safety		EN 60825-1:2014	Laser Class 1

Table 5
ABSOLUTE MAXIMUM RATINGS

These are the absolute maximum ratings at or beyond which the component can be expected to be damaged.
Notes:

1. *260 °C for 10 seconds, one time only, at least 2.2 mm away from lead root.*
2. *Reference: JS-001-2017 Human body model, contact discharge.*

Parameter	Symbol	Minimum	Maximum	Unit
Storage Temperature Range	T_{stg}	-40	100	°C
Operating Temperature Range	T_{Opt}	-40	85	°C
Soldering Temperature [1]			+260	°C
Supply Voltage	Vcc	-0.5	4	V
Electrostatic discharge level [2]	ESD		500	V

Table 6
TRANSMITTER OPTICAL-ELECTRICAL CHARACTERISTICS

Notes:

1. *Upper optical power limit is set by the class 1 laser requirement. (IEC60825-1:2014).*
2. *Test data was validation over the full temperature range of -40 °C to +85 °C and over the supply range of 3.0 V to 3.6 V.*
3. *Test data represents operation at the maximum data rate of 1250 Mbps using a PRBS7 test pattern unless otherwise stated.*
4. *Optical power is measured when coupled into 0.2 m of a 1 mm diameter 0.5 NA POF.*

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Notes
DC Supply Voltage	V_{cc}	3.0	3.3	3.6	V	
Operating Current Consumption	$I_{cc,TX}$		4	7.5	mA	
Sleep State Current Consumption	I_{Sleep}		7.5	10	µA	EN = Low
Data Rate		500		1250	Mbps	
Input Single Ended Voltage Swing	V_{IS}	100		500	mV	
Input Differential Voltage Swing	V_{ID}	200		1000	mV	
Input Common Mode Voltage	V_{CM-in}	0		340	mV	
Differential Input Impedance	Z_{IN}	80	100	125	Ohm	
Enable High	$V_{EN,H}$	1.5		V_{cc}	V	
Enable Low	$V_{EN,L}$	0		0.4	V	
Enable Delay Time				5	µs	
Disable Delay Time				5	µs	
Peak Wavelength	λ_{-peak}			860	nm	
Spectral Bandwidth (FWHM)	$\Delta\lambda$		0.3	0.65	nm	
Average Output Power	P	-3		0	dBm	[1], [4]
Extinction Ratio	ER	6			dB	
Optical Rise Time (20%-80%)	t_r			0.4	ns	
Optical Fall Time (80%-20%)	t_f			0.4	ns	
Power Up time				500	ns	
Total Jitter				230	ps	

Table 7
RECEIVER OPTICAL-ELECTRICAL CHARACTERISTICS

Notes:

1. *Test data was validated over the full temperature range of -40 °C to +85 °C, and over the supply range of 3 V to 3.6 V.*
2. *Test data represents operation at the maximum data rate of 1250 Mbps using a PRBS7 test pattern unless otherwise stated.*
3. *Optical power was coupled from a minimum 0.5 m length of 1 mm diameter core and 0.5 NA step index POF.*
4. *Measured by an oscilloscope with 50 Ohm termination for each data input line or using a 100 Ohm terminated differential probe.*
5. *RSSI is a 1:1 current mirror of the photodiode current (Ipd) and can be used as an RSSI output by dropping across a 1 k resistor.*

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Notes
DC Supply Voltage	V_{cc}	3.0	3.3	3.6	V	
Operating Current Consumption	$I_{cc,TX}$		4	6	mA	
Sleep State Current Consumption	I_{Sleep}		<1	2	µA	No PD modulation current
Data Rate		500		1250	Mbps	
Optical Overload		-1			dBm	
Receivable Optical Power Sensitivity				-16	dBm	
Differential Output Impedance	Z_{DR}	80	100	125	Ω	
Output Common Mode Voltage	V_{OUT-CM}	180		330	mV	
Output Single Ended Voltage Swing	$V_{OUT-single}$	150	200	230	mV	
Output Differential Voltage Swing	$V_{OUT-Diff}$	300	400	460	mV	[4]
Receive Signal Strength Indicator		I_{pd}- 15%	I_{pd}	I_{pd}+ 15%		[5]
Output Rise Time (20%-80%)	T_R			300	ps	
Output Fall Time (20%-80%)	T_F			200	ps	
Re-Activation Time Delay				100	µs	
Sleep Mode Time Delay				5	µs	
Propagation Delay	T_P			3	ns	
Receiver Jitter				300	ps	Perfect Input Signal

MECHANICAL DATA

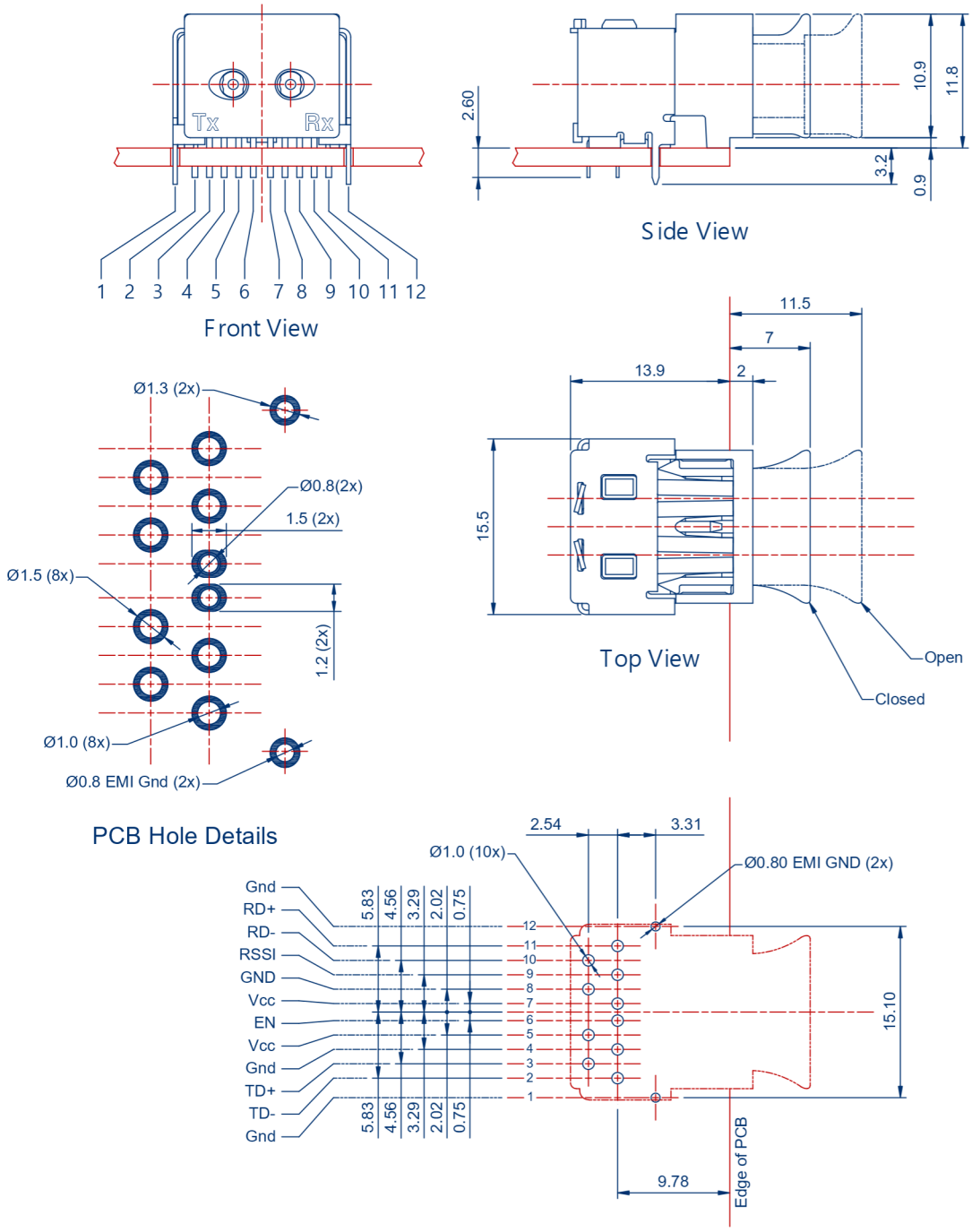


FIGURE 5
Mechanical dimensions of the product and top view PCB footprint - general dimensional tolerance is ± 0.2 mm

NOTE: For PCB layout extra care is required with pin 6 and pin 7. On the PCB top and bottom metal they require a non-circular pad. The VIA's are standard plated circular through holes, however, the VIA top and bottom solder pad areas are non-circular 1.2 mm wide and 1.5 mm long oval shapes.

LASER SAFETY

The FB01GKUJ is an invisible light emitting device operating at a wavelength of 850 nm with a diverging beam diameter. Invisible radiation is emitted from the front of the device with a maximum optical power of 1 mW. This device is classified as class 1 per EN 60825-1:2014.

CAUTION: **Invisible Laser Radiation – Avoid long term viewing of laser.**